

Folate (Folic Acid) November 28, 2005

Background

Everyone requires daily folate / folic acid. Women of childbearing age can improve birth outcomes and decrease the risk of birth defects by ensuring adequate folic acid intake.

Folate is required for DNA synthesis and cell division, red blood cell formation, some metabolic reactions involving lipids (fats) and amino acids (proteins), and it functions as a coenzyme.¹ Because of the rapid maternal and fetal cell division and tissue growth of pregnancy, especially in the first months, there is an increase in folate requirements. It is recommended that women begin taking additional folic acid prior to pregnancy and during pregnancy and lactation. This daily consumption of folic acid prior to pregnancy reduces the risk of neural tube defects (NTDs) by 50-75%.² NTDs are serious birth defects of the spine (spina bifida) and brain (anencephaly). In 2005, 67% of women in the United States were not consuming a vitamin containing folic acid daily.³

Folate, an essential micronutrient, is a water-soluble B vitamin, also called vitamin B 9. Folic Acid is the form of folate that is found in supplements and added to fortified foods.⁴ Folic acid is approximately twice as bioavailable as naturally occurring food folate. In addition to a healthy varied diet, women of childbearing age should consume 400 micrograms of folic acid every day.⁵ (See Table 1)

Benefits of Adequate Folate / Folic Acid Intake⁶

- Promotes normal fetal growth and development
- Reduces risk of birth defects, such as neural tube defects (NTDs) of brain, skull and spinal cord, orofacial clefts, cardiovascular malformations, and urinary track defects
- Decreases miscarriage, spontaneous abortion and fetal death
- Decreases folic acid deficiency and folic acid deficiency anemia
- Decreases homocysteine which might prevent some cardiac disease and colorectal cancer
- During lactation, breast milk is the folate source for the breastfed infant

Folate Deficiency

The cause of inadequate folate may be because of increased need due to pregnancy or lactation, a genetic predisposition to folate deficiency, which results from a decrease in the active form of methylene tetrahydrofolate reductase⁷, insufficient dietary folate or folic acid supplement intake, or abnormal absorption, excretion or metabolism of folate. The negative consequences of inadequate folate during pregnancy include impaired fetal growth and development, neural tube defects (NTDs) including spina bifida and anencephaly and possibly other congenital anomalies including orofacial clefts, cardiovascular malformations and urinary track defects.

The evidence is inconclusive regarding the benefit of high doses of folic acid in women with other risk factors for NTDs. Other risk factors for NTDs are preconception and early pregnancy overweight and obesity⁸, diabetes, use of some antiseizure medications and prolonged high temperatures early in pregnancy such as hot tub use or fever.⁹

Elevated homocysteine reflects inadequate folate intake or abnormal folate metabolism. Elevated homocysteine has been directly associated with some non-NTD adverse pregnancy outcomes, and with an increased risk of cardiac disease and colorectal cancer. It might be a factor in mental health disorders and treatment.¹⁰

Recommendations for Folic Acid

The importance of folic acid as a public health issue is addressed by the U.S. Department of Health and Human Services, Healthy People 2010 objective to decrease NTDs and increase optimal folic acid intake.¹¹

Folic Acid Related Healthy People 2010 Objectives¹²

- 16-15 Reduce the occurrence of spina bifida and other neural tube defects (NTDs)
- 16-16 Increase the proportion of pregnancies begun with an optimum folic acid level

The Dietary Reference Intakes (DRI) for folate are given in Dietary Folate Equivalents (DFEs).^{13 14} Dietary folate equivalents may be expressed in different ways, depending on the type of conversion needed. DFEs include a combination of naturally occurring food folate from a varied diet and folic acid from supplements and fortified foods. Other publications might use micrograms of folic acid per day. To simplify the translation of the recommendations, this publication uses micrograms of folic acid per day.

Dietary Folate Equivalents (DFEs)^{15 16}

- 1 mcg DFE = 1.0 mcg food folate = 0.6 mcg (of folic acid added to foods = 0.5 mcg folic acid taken without food)
- 1 mcg folic acid as a fortificant = 1.7 mcg DFE
- 1 mcg folic acid as a supplement, fasting = 2.0 mcg DFE.

Folate / folic acid needs are increased for all these women: women of childbearing age, pregnant and lactating women, those with a history of NTD, who have some preexisting conditions or diseases, take certain medications or use various substances. The recommendation for women at a higher risk for a NTD affected pregnancy, i.e. a history of NTD-affected pregnancy, a family history of NTDs or being an individual with a NTD, is to consume 4,000 mcg (4.0 mg) folic acid prior to and during the first months of pregnancy.¹⁷

The summary of recommendations for Folate/ Folic Acid (Table 1) have taken the DFE calculations into account and using the Institute of Medicine (IOM)¹⁸, Centers for Disease Control and Prevention (CDC)¹⁹, and US Department of Health and Human Services U.S Public Health Service (USPHS) recommendations²⁰, an adapted user friendly format of micrograms of folic acid per day is shown below.

Table 1: Summary of Recommendations for Folate/ Folic Acid ^{21 22 23 24}

Life-stage Group	U.S. Public Health Service and the Institute of Medicine Recommendation	Comments
Women of child-bearing age	400 mcg (0.4 mg) folic acid/day	All women capable of becoming pregnant An average daily intake is approximately 200 mcg (0.2mg) from unfortified foods.
Pregnant women	400 mcg (0.4 mg) folic acid/day	Plus unfortified foods for a total intake of 600 mcg (0.6mg) DFE/day There may be increased need for more than one fetus. There are no additional guidelines at this time.
Previous NTD-affected pregnancy or family history showing a high risk of NTDs, planning a pregnancy	4000 mcg (4.0 mg) folic acid/day after consulting with prescribing health care provider	To decrease the risk for NTD in women who have: <ul style="list-style-type: none"> • A NTD-affected • A NTD • A genetic risk By prescription , starting one month before conception and continuing throughout the first 3 months of pregnancy. Then reduce to 400 mcg (0.4 mg) folic acid/day.
Lactating women	400 mcg (0.4 mg) folic acid/day	Plus unfortified foods for a total intake of 500 mcg/day <ul style="list-style-type: none"> • To replace folate secreted in breast milk and maintain maternal folate status. • There may be increased need for more than one infant.
Infant from birth to 3 months	25-100 mcg (0.25-0.1mg) folic acid/day	Folate / folic acid intake is considered adequate when the baby is <ul style="list-style-type: none"> • Breastfed by a mother consuming 400 mcg (0.4 mg) folic acid/day. • Fed commercial artificial baby milk
Other NTD risk factors, when planning a pregnancy, include: <ul style="list-style-type: none"> • Obesity • Seizure disorder • Diabetes 	≤ 4000 mcg (4.0 mg) folic acid/day	Consult with a health care provider prior to pregnancy Preconception and prenatal assessment and education to include <ul style="list-style-type: none"> • Self management status and training • Control of condition • Medication

Consequences of Excessive Intake of Folate / Folic Acid

Folic acid toxicity risk is low. Folate is a water-soluble vitamin, so excess intake is usually excreted in urine.²⁵ The tolerable upper limit (UL) only includes folic acid from fortified or enriched foods or supplements or a combination of the two. It does not include naturally occurring food folates.²⁶ The average amount of folate consumed, from unfortified foods, averages 200 mcg (0.2 mg) per day and is not of concern.

The UL of folic acid for women ²⁷

- 14-18 years old is 800 mcg/day (0.8 mg) per day
- 19-50 years old is 1,000 mcg (1.0 mg) per day

Sources of Folate / Folic Acid

Adequate amounts of dietary folate / folic acid from a variety of foods and beverages should be consumed daily. This also provides other nutrients that are essential components of a healthful diet. In addition to naturally occurring food folate, all women of childbearing age, should be encouraged to consume folic acid in the recommended doses. Table 2 summarizes some sources of folate / folic acid.

Table 2: Sources of Folate / Folic Acid ²⁸

Source	Dietary and supplement sources include, but are not limited to
Foods naturally folate rich	<ul style="list-style-type: none">• Legumes, i.e. blackeye peas, lentils, black beans, navy beans, pinto beans• Dark green leafy vegetables, i.e. spinach, collards, turnip greens, broccoli, asparagus, okra• Citrus fruits and juice, i.e. orange• Nuts and nut butter, i.e. peanuts, almonds, pecans, mixed nuts• Sunflower seeds• Meat, eggs
Folic acid fortified or enriched foods with less than 400 mcg folic acid per serving	Folic acid enriched or fortified cereals, bread, flour, cornmeal, pasta, rice and other grain products
Folic acid fortified or enriched foods with 400 mcg folic acid per serving	Enriched or fortified cereals with ≥ 400 mcg (0.4 mg) folic acid per serving (Since folic acid is sprayed on fortified cereal and this washes off with milk, the milk left in the cereal bowl should be consumed.)
Oral folic acid supplement	*Prenatal or multiple vitamins and minerals with folic acid or folic acid supplements which only contain folic acid

*No individual should consume more than one multivitamin a day because of possible toxic dose of other nutrients such as vitamin A.

Nutrition Assessment of Folic Acid Intake

After a positive screen for anemia, screen for folic acid (Table 3) and B12 deficiency. Screening for anemia includes identifying risks, such as a positive CBC or a positive health history, such as being a vegan.

Table 3: Folate / Folic Acid Assessment²⁹

Assessment Area	Assessment Data	Comments
Biochemical	<ul style="list-style-type: none">• Decreased serum folate• Decreased red blood cell folate• Increased serum homocysteine	<ul style="list-style-type: none">• Serum folate is a short term indicator of deficiency• Red blood cell folate is a long-term indicator of reduced body stores. Maintenance of red cell folate is an indicator of adequacy of folate status during pregnancy.• Serum homocysteine reflects inadequate folate intake or metabolism
Clinical factors	Clinical assessment criteria - See Table 2	
Dietary practices and patterns	Sources of folate / folic acid - See Table 3	

Increased folate / folic acids needs

Table 4 summarizes some specific criteria for the clinical assessment of individual folate/ folic acid needs. In those women with vitamin B12 deficiency, excessive intake (usually >5.0 mg) of folic acid supplements might mask or delay the diagnosis of vitamin B12 deficiency. Vitamin B12 deficiency can cause neurological damage.³⁰

Table 4: Increased Folate / Folic Acid Needs ^{31 32 33 34}

Increased folate / folic acid needs, include, but are not limited to	Clinical assessment criteria include, but are not limited to
Reproductive status	<ul style="list-style-type: none"> • All women of childbearing age • Pregnancy • Lactation
NTD history	<ul style="list-style-type: none"> • Previous NTD-affected pregnancy • Individual with NTD • Family history of NTD
Preexisting conditions or diseases	<ul style="list-style-type: none"> • Folate deficiency or folate deficiency anemia • Genetic defect which decreases methylene tetrahydrofolate reductase effectiveness • Gastrointestinal malabsorption/ prior bariatric surgery • Kidney dialysis • Liver disease
Medication intake	<ul style="list-style-type: none"> • Anticonvulsant medications such as Primidone, Phenytoin (Dilantin™), Carbamazepine (Tegretol™) • Metformin (Glucophage™ or Glucophage XR™) which may be prescribed for pre-diabetes, type 2 diabetes or polycystic ovary syndrome (PCOS) • Methotrexate which may be prescribed for arthritis, cancer or other autoimmune disease • Sulfasalazine for Crohn's Disease or ulcerative colitis • Some diuretics such as Triamterene (Dyazide™) • Chronic use of nonsteroidal anti-inflammatory drugs such as aspirin, ibuprofen, acetaminophen • Barbiturates used as sedatives
Substance Use	<ul style="list-style-type: none"> • Alcohol, chronic excessive consumption • Cigarette smoking

Nutrition Education

Because folate is water soluble, cooking methods and duration affect food folate retention, particularly in green vegetables.³⁵ Practical advice about food preparation and the retention of water-soluble vitamins is encouraged, e.g. to steam or cook vegetables in small amounts of water for short periods of time.

When educating women on consuming 400mcg of folic acid daily, include these points:

- Encourage daily consumption of folate / folic acid rich foods and folic acid fortified foods along with one of the following:

- Cereal fortified with ≥ 400 mcg (0.4 mg) folic acid per serving
- Folic acid supplements or
- Prenatal or multiple vitamins and minerals with folic acid
- Teach cooking methods which retain folate, particularly in green vegetables (4)
 - Steaming in preference to boiling
 - If boiling, do so for a short time in a minimum of water
 - Use folate rich cooking water in other food preparation
- Discourage use of:
 - Cigarettes
 - Alcohol

Referrals

Multidisciplinary interventions contribute to improved short term and long term health maternal and fetal outcomes. When there is an identified need for consultation, assessment, intervention, therapy or resources, refer to the appropriate health care professionals, who have expertise in nutrition and health:

- Medical Nutrition Therapy Specialist (RD)
- Behavioral Medicine Specialist (LCSW, MSW, MFCC, MD, PhD)
- Healthcare Provider (MD, DO, PA, CNP, CNM)
- Lactation Specialist (CLC, IBCLC, CLE)
- Women, Infants and Children (WIC) Supplemental Nutrition Program
- Other specialist

Resources

Get the folic acid you need handout from California Department of Health Services, Maternal and Child Health Branch, Office of Perinatal Health. Steps to take, Comprehensive Perinatal Service. Program guidelines for enhanced health education, nutrition, and psychosocial services. CA Department of Health Services, 2001.

Folic Acid: Every Woman, Every Day, Maternal and Child Health Branch, CA Department of Health Services. Available through local March of Dimes offices.
 English: <http://www.mch.dhs.ca.gov/documents/pdf/eng-folicpamp.pdf>
 Spanish: <http://www.mch.dhs.ca.gov/documents/pdf/span-folicpamp.pdf>

Useful web sites

- CDC Folic Acid <http://www.cdc.gov/ncbddd/folicacid/>
- CDC Reproductive Health <http://www.cdc.gov/nccdphp/drh/mh2.htm>
- March of Dimes www.modimes.org
- National Council on Folic Acid: www.folicacid.net
- National Folic Acid Council: <http://www.folicacidinfo.org>
- National Birth Defects Prevention Network: <http://www.nbdpn.org>

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